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Miami enters the Metro era

July 1984

RAILWAY AGE

...for the new age of railways

Change in the '80s
The meaning of merger

Midyear report
The state of the industry

New directions in detectors

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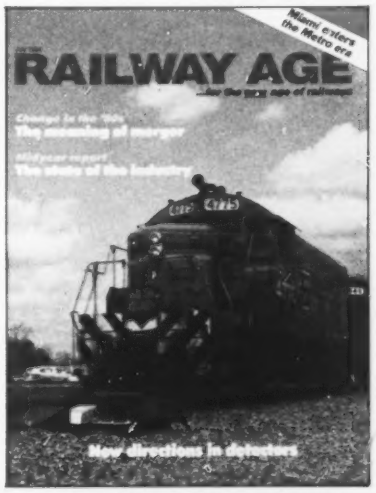
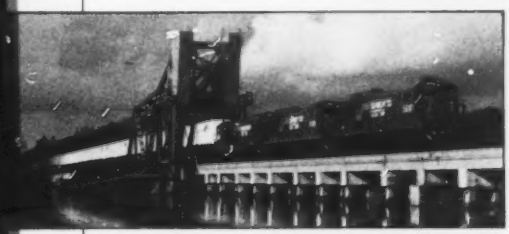


Cover: Hotbox detector on Seaboard; photo by Roy Blanchard. *Page 78.*



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Approaching its 50th birthday, the Newark City Subway is emerging from a modernization program with a new look—and a virtually new roadway.

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Inside

Profits and paradoxes

LUTHER S. MILLER

A friend who is in the banking business asked us the other day how the railroads were doing. Our reply was, "They are doing beautifully, and as a result they are in deep trouble." The paradox in that statement is reflected in the headline that appears over our midyear report on the state of the industry—"The comeback blues." It is explained (though probably not to the satisfaction of the electric utilities and the railroad labor organizations) in the text that follows.

It is a fact that the railroads this year are turning in a quite remarkable financial performance: First-quarter profits of nearly $600 million were triple those of the corresponding 1983 period. For the year as a whole, net earnings could top $2.5 billion. Return on investment is nudging 5%.

But the railroads could turn out to be victims of their own success. Certain big shippers, led by utility and coal interests, are saying that the Staggers Act, which has helped produce the turnaround, has worked all too well and that it's time now to turn back the clock. The unions, for their part, are making demands that could wipe out the productivity gains that have also contributed mightily to the railroad comeback.

Says AAR President William H. Dempsey: "There's a lot of euphoria around right now, but it isn't entirely justified."

That's what "The comeback blues" is all about. It starts on p. 37.

Busy days north of the border

CN Rail moved 16.4 billion gross ton miles of freight in May of this year, more than in any other month in its history. The previous record was 14.7 GTMs in May 1981.

"Our determination to press ahead with expansion work in the West even during the recession year of 1982 has stood us in good stead," says Ronald E. Lawless, CN Rail's president and chief operating officer. "Without the added capacity we've built into the system since 1980 we simply could not have handled this record amount of freight."

CN Rail is not alone in its reconquest of the West. Rival CP Rail is also pushing for expanded capacity to help position Canada for a major thrust into the markets of Asia. Smaller but no less aggressive, British Columbia Rail is doing its part. Altogether, the three railroads will invest close to $5 billion in expanding western rail capacity by 1990.

"Canada's western strategy" is described by Associate Editor Frank Malone in the story that starts on p. 85.

Market Outlook

Equipment

Amtrak: Will rebuild six former Santa Fe bi-level dining cars and six former Southern single-level coach/lounge cars into food service cars at Beech Grove, Ind.

CN Rail: Placed a $1-million order with Ryder J.H. Machinery Ltd. for three heavy-lift container handling machines manufactured by Clark Equipment.

Government of Canada: Will acquire 2,460 grain hopper cars this year—980 from National Steel Car, 620 from Marine Industries, and 860 from Hawker-Siddeley Canada. The government ordered 1,380 cars last year. The new orders will fulfill the government's promise to acquire 3,840 new grain cars by the end of 1985.

Southern Pacific: Ordered 50 new diesel-electric locomotives at a cost of $52 million. The Electro-Motive Division of General Motors will supply 34 3,000-hp GP40 units; General Electric will supply 16 3,750-hp B36-7 units. Delivery is to begin in September.

- Placed a $5.1-million order with Thrall Car for 150 fully-enclosed tri-level autoracks. Delivery will begin in August.

Union Pacific System: Ordered 615 autoracks—345 tri-levels and 270 bi-levels—from Portec, for delivery this fall. The order, valued at $18.8 million, is in addition to a previous order for 325 autoracks (*RA*, April, p. 12).

Freight cars

	DELIVERED				
	May		April	Five Months	
	1984	1983	1984	1984	1983
Built new by carbuilders	755	376	722	3,127	1,766
Built new in RR shops	0	0	0	0	200
Built new—total	755	376	722	3,127	1,966
Rebuilt	0	0	0	0	0
TOTAL DELIVERED	**755**	**376**	**722**	**3,127**	**1,966**
	ORDERED				
To be built new by carbuilders	1,301	797	672	7,445	2,416
To be built new in RR shops	0	0	0	0	3
To be built new—total	1,301	797	672	7,445	2,419
To be rebuilt	0	100	0	0	100
TOTAL ORDERED	**1,301**	**897**	**672**	**7,445**	**2,519**

	ON ORDER AND UNDELIVERED				
	June 1		May 1	Average Backlog	
	1984	1983	1984	1984	1983
To be built new by carbuilders	5,723	4,744	6,742	6,317	4,235
To be built new in RR shops	0	3	0	0	53
To be built new—total	5,723	4,747	6,742	6,317	4,288
To be rebuilt	0	100	0	0	20
TOTAL ON ORDER	**5,723**	**4,847**	**6,742**	**6,317**	**4,308**

Source: American Railway Car Institute

Locomotives (new and rebuilt)

DELIVERED	1984	1983
April	39	28
March	28	26
Four Months	115	90

BACKLOG	1984	1983
May 1	249	127
April 1	93	134
Average	127	77

Source: Transportation Div., AAR

Facilities

Bay Area Rapid Transit: Is requesting proposals for construction management services for its $150-million Daly City Turnback and Yard Project, which will involve 27 separate contracts. The estimated construction management fee, over a three-year period, is $3.5-to-$4 million.

Chessie: Is installing a $14-million IBM model 3084QX IBM mainframe computer system at its operating headquarters in Baltimore. The system includes 48 million bytes of main memory, 61 billion bytes of on-line disk storage and can perform 29 million instructions per second.

Conrail: Placed a $400,000 order with General Electric for 80 Series Six programmable controllers to monitor and remotely control switches and signals.

Glenayre Electronics: Has received orders exceeding $3 million (Canadian) from Chessie and Conrail for the DIGITAIR rear-of-train information system. Orders for test programs have been placed by CN Rail, CP Rail, Illinois Central Gulf, and Santa Fe.

Sacramento Transit Development Agency: Pacific Rail Road Constructors of Torrance, Calif., is the apparent low bidder (at $3,964,550) for construction of the first 5.3-mile segment of STDA's 18-3-mile light rail line. The bid was 12% below the agency's estimate.

Market Indicators

DRI Railroad Industry Monitor

The rail traffic recovery that began in the end of 1982 is now expected to peak by the third quarter of this year. Coal traffic will weaken as utilities comlete their stockpile building in anticipation of a UMW strike, and whether or not there is a lengthy strike fourth quarter coal carloadings will be down sharply. The overheating economy has choked off the recovery in housing, and the demand for a wide range of building materials has already softened. New car sales have held up well despite the rise in interest rates, but sales are expected to fall off slowly during the second half of the year.

While the expected decline in rail traffic will put pressure on earnings, it may ultimately help the railroad industry. Unless management negotiators can win a pact combining productivity gains and wage restraint, the railroad industry will continue to lose market share in manufactured goods to trucks and the rail unions will continue to lose jobs at a rapid rate. If the slowdown in traffic brings an added sense of urgency to management and an added sense of realism to rail labor, the long-term benefits of the traffic slowdown will outweigh the short-term losses.

	1984:1	1984:2	1984:3	1984:4	1985:1
Economic Indicators (annualized rates)					
Industrial production (1967 = 1.0)	1.60	1.64	1.67	1.68	1.69
Housing starts (mil. units)	1.96	1.86	1.77	1.67	1.60
Retail car sales (mil. units)	10.6	10.6	10.5	10.5	10.4
Raw steel production (mil. tons)	25.1	28.2	24.2	25.4	28.3
Total Class I Rail Traffic					
Millions of tons	338.4	347.7	341.3	331.5	322.2
Billions of ton-miles	223.0	223.6	218.9	218.2	224.6
Key Commodities					
Grain	36.2	30.9	28.2	30.8	32.1
Coal	133.4	133.7	134.5	131.7	127.6
Lumber & Wood	5.1	5.4	5.1	4.8	4.7
Pulp & paper	9.3	9.0	8.8	8.6	8.9
Chemicals	27.3	26.8	26.2	26.2	28.0
Motor vehicles	6.1	6.3	5.1	5.9	5.5

Source: Data Resources, Inc., June 25, 1984

Revenue freight carloadings

Commodity	June 16 week	% change from 1983	June 9 week	% change from 1983	June 2 week	% change from 1983	May 26 week	% change from 1983	May 19 week	% change from 1983
Grain	24,062	(2.8)	24,078	11.9	21,308	25.7	23,171	6.3	23,764	23.7
Other farm products	3,766	(18.6)	3,985	(17.3)	3,838	8.6	3,823	(9.6)	3,905	10.0
Metallic ores	19,133	(11.4)	21,997	0.8	19,017	2.0	20,736	(1.2)	20,232	(2.3)
Coal	125,628	19.9	129,610	24.5	114,693	25.7	130,573	24.9	121,390	20.8
Crushed stone, gravel and sand	12,880	9.8	13,041	13.1	10,583	9.0	13,218	19.8	13,662	18.8
Nonmetallic minerals	12,814	26.3	12,467	14.7	11,415	6.7	10,583	(8.5)	12,526	14.8
Grain mill products	10,070	(9.4)	10,702	(9.9)	9,422	(8.5)	11,059	(6.7)	10,746	(5.4)
Food and kindred products	10,708	(1.8)	10,971	(0.7)	9,398	(5.7)	10,843	(9.0)	10,583	(9.9)
Primary forest products	13,733	(8.3)	14,347	0.0	13,004	(3.0)	14,186	(1.7)	14,711	1.7
Lumber and wood products (except furniture)	7,219	(4.1)	7,371	(5.5)	6,597	2.0	7,967	(5.3)	7,207	(8.4)
Pulp, paper and allied products	14,858	(3.5)	15,335	3.5	14,737	1.3	15,322	(2.1)	14,328	(6.8)
Chemicals and allied products	23,020	2.0	23,769	6.2	22,117	10.8	27,274	22.9	26,892	19.9
Petroleum products	4,870	3.2	4,768	0.9	4,192	2.0	4,882	3.1	4,780	(0.2)
Stone, clay and glass products	11,662	7.0	11,660	3.8	10,433	4.9	12,199	7.6	12,160	12.3
Coke	6,029	12.0	5,954	9.5	5,802	11.3	5,718	6.8	5,676	16.7
Metals and products	9,816	17.7	9,510	19.5	10,620	32.5	10,566	20.9	10,255	24.3
Motor vehicles and equipment	20,999	13.0	20,493	7.3	17,356	12.1	20,272	9.6	21,337	14.7
Waste and scrap materials	9,626	15.3	9,884	17.6	8,795	28.5	10,593	17.9	10,412	19.2
Forwarder and shipper assn. traffic	7,098	(16.3)	7,427	(9.6)	5,963	(16.7)	6,570	(25.2)	7,118	(17.1)
All other carloads	58,548	12.6	60,980	25.0	52,785	22.5	63,134	22.2	59,367	18.8
LCL traffic	237	10.2	219	(22.9)	200	(11.5)	273	(8.4)	242	(10.7)
Total Cars Loaded	**406,776**	**7.9**	**418,568**	**12.8**	**372,280**	**14.4**	**422,962**	**12.2**	**410,693**	**12.8**

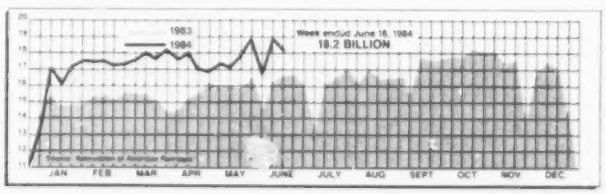
Estimated revenue ton-miles (billions)	1984	1983	% change from 1983
24 weeks	426.4	367.7	16.0

Piggyback loadings

Week ended	Cars loaded 1984	% increase from 1983	Trailers containers 1984	% increase from 1983
May 12	52,706	19.5	89,716	16.6
May 19	52,436	16.2	87,721	11.6
May 26	52,836	13.6	88,786	10.1
June 2	43,356	10.2	77,582	15.9
June 9	50,027	13.2	87,924	14.5
Cumulative total, 23 weeks	1,157,835	18.0	1,998,321	18.2

Rail freight traffic trends

Billion ton miles (Estimated)



Midyear report:

The comeback blues

Traffic is up, costs are under control, and earnings are soaring. But the very strength of the railroad comeback could mean trouble in Congress and at the labor bargaining table.

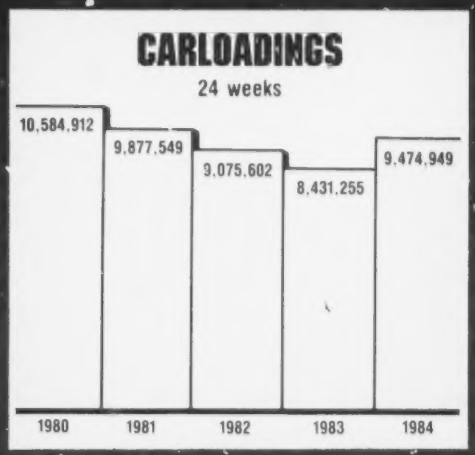
By LUTHER S. MILLER, Editor

Sample the mood of railroad executives at midyear '84, and you find a curious mixture of euphoria and anxiety.

The euphoria is easily accounted for. Traffic is running strongly ahead of '83 levels; revenues are increasing faster than costs; earnings have shot up dramatically. Class I railroads reported net income of over half a billion dollars in the first quarter, which is historically not their best. Barring a downturn not now foreseen, they expect to earn $2.5 billion before the books are closed on this turnaround year.

Less evident, but no less real, are the reasons for apprehensiveness.

Much of the railroad industry's present prosperity has been gained through skillful exercise of the pricing freedoms granted by the Staggers Act of 1980—and that Act is now under mounting attack in Washington. Shipper lobbies are filling their war chests with millions of dollars for a 1985 assault on Staggers—a threat that Association of American Railroads President William H. Dempsey regards as "formidable."



Meanwhile, the railroad labor organizations have slapped onto the bargaining table wage, benefit and work-rules demands that, if only partially successful, could put the railroads hopelessly behind in their productivity race with motor carriers, which are rapidly becoming a de-unionized industry.

Rarely has the industry's short-term picture looked so bright and its long-term outlook so cloudy. First, the bright side.

• The year so far. By all of the standard measurements, the railroads are going through a period of extraordinary turnaround.

In this year's first quarter, on the strength of a 12% increase in revenue ton-miles, the Class I's posted net income of $593 million, three times as much as they earned in the "comeback" first quarter of 1983. Revenues were up more than $1 billion; costs rose by only $613 million. Contributing factors were continued low levels of employment (in mid-April of this year Class I roads employed 322,525 people, down 1.78% from the

Photo: Roy Blanchard

Financial performance: '84 vs '83

	First quarter 1984	First quarter 1983
Operating revenues	$7,451,000,000	$6,376,000,000
Operating expenses	6,619,000,000	6,006,000,000
Net revenue from operations	832,000,000	370,000,000
Ordinary income	593,000,000	182,000,000
Net railway operating income	564,000,000	264,000,000
Rate of return (12 mos. ended Mar. 31)	4.26%	2.48%

Source: Association of American Railroads

Note: First quarter '84 figures are stated on the new depreciation accounting basis; '83 figures are on the old betterment accounting basis. It's estimated that the new accounting may have had the effect of increasing first-quarter '84 net revenue from operations by 15-20%.

year-earlier figure) and only modest increases, if any, in the costs of fuel, materials and supplies.

Prospects for the rest of the year are good. At midyear, traffic was 16% ahead of '83 levels. That rate of increase will not continue; more and more, this year's traffic will be compared with last year's improving levels. And the anticipated coal miners' strike, which has been responsible in recent weeks for unusually heavy coal traffic as users have built up inventories, will erode about 12% of total ton-miles for its duration.

Nonetheless, the sustained ton-mile increase this year will be in the 8% to 9% range, by conservative estimate, and the railroads expect to more than double last year's net income of $1.2 billion.

But they also expect, soon after that, to run into some heavy weather.

• **The assault on Staggers.** Most troublesome, right now, is the prospect of having to go back to Capitol Hill next year to re-wage the fight they won in 1980.

A number of shippers want changes in the Staggers Act. Agricultural interests are worried about the confidentiality aspects of contract rates. The National Industrial Transportation League is concerned about the elimination of joint rates, the closing of gateways, and boxcar deregulation.

But it is the utility and coal interests, joined by some consumer groups, who really intend to turn back the clock. They want drastic revamping of market-dominance standards; they want the ICC to scrap the cost of capital as a standard for revenue adequacy. And they have banded together as Consumers United for Rail Equity (CURE) to try to persuade Congress to de-gut Staggers.

How strong is the opposition? "Formidable," says the AAR's Bill Dempsey, but he thinks the railroads' have an "impregnable" defense if they can only get it together.

Dempsey demonstrated his own skills as a defender of the faith when he appeared recently before the National Conference of State Legislators to argue against a resolution calling for ten major changes in Staggers—a resolution which NCSL at that time seemed almost certain to adopt.

It is claimed, said Dempsey, that coal prices are falling while rail coal rates are soaring—a charge, he added, that is "supported with the statistical equivalent of mirrors—the use of carefully selected slices of time." By looking at the 1972-1982 period—"pertinent because it embraces the OPEC oil crisis"—Dempsey was able to redraw the picture.

In 1982, he said, the price of coal was 32% higher in constant dollars than it was in 1972, while coal rates were 3% lower in constant dollars. As for utilities, he noted that between Oct. 1, 1980—the effective date of the Staggers Act—and Jan. 1, 1984, electricity rates rose 44% while coal rates rose only 23%.

"The utilities say that they want to reduce coal rates because their transportation costs are now approaching $5 billion per year and those costs must be borne by their consumers," said Dempsey. "If they really have only their customers' interests at heart, I suggest that the utilities agree to absorb the billions of dollars of losses in nuclear power plants that will never operate, rather than attempt to pass those costs on to their consumers. If that course isn't appealing, perhaps the utilities should give their customers a break by seeking only a 10% return rather than the 18% they sought and the 14% they earned in 1984."

Dempsey's arguments carried the day, and the anti-Staggers resolution was defeated. He did not even have to point out that while the railroads are now at their most prosperous position in many years, they still have a rate of return that is only slightly more than 4%.

• **The productivity squeeze.** It is not only the backlash against Staggers that is worrying Dempsey and others who try to look beyond this year's financial statements. There is the whole question of where even an unregulated railroad industry is ultimately headed—and how it is going to get there. In a blunt talk before the Railroad Public Relations Association at Colorado Springs in June, Dempsey looked bleakly down the road to a narrowing transportation market, and hopefully to the productivity gains that will help the railroads win a bigger share of that market.

"There's a lot of euphoria around right now," said Dempsey, "but it is not totally justified.

"Yes, business is much better than it was in 1982 and much of 1983. But look at it carefully, leaving piggyback aside since piggyback operates on thin margins. Look at the high-rated stuff. Last time I looked, things like metallic ores, and lumber and wood products were still down from a decade ago.

"Why hasn't this brought gloom? Because railroads moved so aggressively during the recession to reduce their costs. So even moderate traffic growth produced results that suggest greater business growth than has actually occurred.

"Furthermore, every forecast I've seen indicates that the transportation market is not going to grow significantly over the next 10 years. We will no longer be able to count on growth that comes from an overall increase in the total load. If we are to grow, we have to increase our share.

"Since 1970, we've had a 41% gain in revenue ton-miles per mile of road operated—largely a result of paring away about 15% of the national rail system. And, as a result of drops in employment, revenue ton-miles per employee have grown by more than 50% in that same time period. That's pretty good, but we have to do better.

"Our competition has been growing more productive, too. The law now allows bigger, longer, heavier trucks to challenge railroad piggyback service. Trucking companies have moved to reduce their employment of Teamster drivers in favor of independent contractors.

"It is time for the leaders of our railroad unions to recognize that the interests of their members lie in helping this industry to grow. It is time for them to understand that true leadership is not clinging blindly to every crumb of unearned advantage that they have ever been able to get—but in analyzing the situation and recognizing the simple truth that they can only prosper as the railroad industry prospers."

• **The showdown.** What Dempsey was saying was that any real railroad growth in the future is going to come from the highways—and in the showdown, it's the high-productivity carrier that is going to win.

Right now, the truckers seem to have the edge. AAR Executive Vice President Richard E. Briggs analyzes the situation this way:

"According to the ICC, since 1980 the number of regulated motor carriers has increased from under 18,000 to almost 31,000—a 74% increase. Most of these new entrants are non-union, truckload carriers, offering lower wages. Additionally, some 125,000 non-regulated, non-union owner operators deliver intercity freight, and recent regulatory reforms are allowing growth in private carrier operations. Between 1977 and 1982, Teamster membership among rail-competitive truck operators declined from 26% to 17%.

For suppliers, a slow turnaround

Many railroad capital-improvement budgets are at record or near-record highs this year. Burlington Northern is spending $684 million, up from $575 million last year. Conrail has budgeted $520 million vs $450 million in '83. Norfolk Southern's plannned outlays of $510 million are more than double actual '83 expenditures. SP has hiked capital spending to $340 million from $286 million last year.

But a large number of old-line equipment suppliers continue to suffer. This is because capital budgets, which until a few years ago were heavily tilted toward freight cars and locomotives, now lean toward plant improvements—in particular, track work. In any case, this year's budgets are inflated in comparison with those of previous years due to the switchover from betterment to rateable depreciation accounting—which means that track work that used to be charged as an operating expense is now carried as a capital outlay.

Still, 1984 has turned out to be a distinct improvement over 1983. In this year's first five months, 7,445 new freight cars were placed on order—more than triple the 2,419 that were ordered in the comparable 1983 period. Locomotive orders are also running ahead of a year ago. In this year's first four months, 115 new locomotives were installed, up from 90 in the '83 period; the undelivered backlog of locomotives on May 1 was 249, nearly double the 127 on order a year ago.

The outlook is for a continuing though relatively slow improvement in equipment orders. Carbuilders estimate that around 15,000 cars will be ordered and 13,000 installed this year. They are more optimistic for 1985, when they see orders recovering to around the 25,000-car level with deliveries climbing to around 20,000.

One reason for the slowdown in equipment orders is the substantially increased utilization that mergers and deregulation have brought about. Despite the 16% increase in traffic so far this year, a vast fleet of cars and locomotives remains in storage.

But many of these may never come out of storage. As more efficient equipment comes onto the market, many railroads will buy it in preference to de-mothballing and/or rebuilding older equipment. This is particularly the case with locomotives. Donald M. Tutko, who is now chief mechanical officer of the Seaboard System and before that was CMO of Missouri Pacific, recently told the following story:

"A year and a half ago, I was involved with a group of associate mechanical officers in developing a program to remanufacture some early model SD-40 locomotives. Our plan was to produce a unit equal to the SD-40-2 locomotive which has been an excellent performer. The SD-40-2 was the workhorse of both our fleets and, given its reliability and maintenance cost, it seemed technologically sound and cost effective to remanufacture older units to the SD-40-2 configuration. But before we finalized our plans, a visit to EMD awoke us to the significant advances in design that EMD was about to announce. Their advances in electrical control and fuel economy quickly convinced us that remanufacture was no longer cost effective. We soon found that both locomotive manufacturers were about to adopt microprocessor technology to their next generation of units."

Other CMO's, as it turned out, were thinking along the same lines—and as a result, several hundred new locomotives have been ordered during a time when thousands have been in storage.

On a smaller scale, a similar story can be told of freight cars. While many thousands of coal cars remain in storage, the emergence on the scene of new lightweight aluminum and aluminum/steel cars has resulted in orders for several hundred. Alcoa, a main supplier of the lightweight metal, is predicting that as many as 7,000 aluminum cars a year could be coming off the line by 1990.

Meanwhile, a whole new generation of piggyback cars is in the making. TTX, which expects to acquire up to 28,000 new piggyback "platforms" (the preferred term now that piggyback cars are increasingly multi-platform, articulated units), has already placed or will soon place orders for 2,000.

More existing equipment will be obsoleted if the railroads succeed in their present quest to develop high-productivity integral trains.

The future is bleak for builders accustomed to single runs of 1,000 or more cars (if, indeed, there are still such builders around). It is bright for innovative builders capable of producing specialized cars in relatively small lots.

FREIGHT CARS: 1985 market forecast

		Average	Median	Range	
				Low	High
1985 orders	All respondents	28,300	30,000	10,500	50,000
	Carbuilders	25,400	23,400	15,000	40,000
	Others	30,800	32,000	10,500	50,000
1985 deliveries	All respondents	23,000	25,000	12,000	35,000
	Carbuilders	21,400	20,300	15,000	30,000
	Others	24,300	25,000	12,000	35,000

Respondents: 11 Carbuilders
13 Components and Others

Source: American Railway Car Institute

ARCI's 1985 market forecast shows that there is considerable difference of opinion among carbuilders and their component suppliers as to what the future holds.

"A three-year contract signed between motor carrier management and the Teamsters Union in 1982 reflects the success of non-union trucking operations. The Teamsters agreed to no general wage increases, reduction in cost-of-living adjustments, and significant work rules improvements designed to further increase truck productivity.

"Since 1980, motor carrier wage increases have lagged significantly those of the railroad industry. Between 1972 and 1983, average annual railroad compensation (wages and fringes) increased by 204%—versus a 137% increase in the consumer price index. In 1983, the $40,792 average annual compensation paid railroad employees was 53% greater than that earned in the trucking industry. The average annual wage of rail workers is greater than that in 58 other industries employing 99% of the domestic work force. Yet, the rail industry ranks near the bottom in terms of financial health."

And that is the bottom line: The railroads look good today only in comparison with where they were yesterday. A less-than-5% return on an investment of $35 billion is better than it has been—but it's a long way from the riches that some railroad customers and some railroad unions appear to feel that the carriers have fallen into. If Congress as it re-considers Staggers—and if the unions as they press new demands—feel otherwise, then the railroad renaissance could be short-lived. ■

Hybrid, microprocessor-upgraded Servo detector installation on the Seaboard System at Goose Creek, S.C. scanning journals on a passing freight. Current railroad wayside defect detection programs include such enhancements as updated scanner monitoring and electronics, on-site heat-signature processing on the basis of refined alarm criteria, data digitization for transmission, and direct radio "talker" identification to train crew members of multiple types and locations of detected defects. Photo: Roy Blanchard

Detectors get smarter

With several thousand hotbox, dragging equipment and other detectors now in place, attention is turning to upgrading and refining their already extensive monitoring capabilities.

By JOHN ARMSTRONG,
Associate Editor

On the basis of a *Railway Age* survey, it appears that sometime late in 1982 the number of hotbox detector installations on U.S. and Canadian railroads passed the 3,000 mark. In 1983, quite possibly for the first time in at least a century, the number of train accidents on U.S. railroads attributed to heat-broken journal bearings dipped below 100.

There's a gratifying connection between these two facts, of course, though the relationship is neither simple nor direct when such factors as shifts in bearing types, car capacity, train speeds and car mileage are cranked in. As AAR hotbox detection and bearing failure statistics over the last decade indicate, year-by-year curves are frequently lumpy despite the large numbers involved. Overall, real improvement has been achieved, even though performance of both plain (solid) and roller bearings has remained about the same and today's smarter wayside detection systems are hard put to do much more than stay even with increasingly stringent needs for sensing and interpreting incipient journal heating indications as the active car fleet creeps toward 100% roller-bearing status.

• **Filling in the gaps.** With the survey showing some 3,100 wayside hotbox detector locations in service, most main lines are approaching the 15- to 25-mile-per-scanner installation density most roads believe justifiable; the 700 or so installations projected for this and the next few years are primarily those needed to provide coverage of new or upgraded sections of main line, to bring up to snuff routes whose installations were deferred or delayed for financial reasons, or to fill the occasional gap left due to a variety of reasons now past.

Roads buying scanners will find no dearth of competition. Of the four scanners described in a previous review (*RA*, Nov. 10, 1980, p. 29), only Marine Electric's HB-76 has with its supplier fallen by the wayside.

—Harmon has acquired and continues to provide spares and service support for the pyroelectric-sensor unit previously built by General Electric; with a new cantilever mounting adaptable to any customer-preferred target of scan (wheel hub, inside- or outside-journal surface) and all-new microprocessor-based electronics, the basic scanner lives on in the Harmon WCO-32 hotbox detector system now in production.

—Servo's current 8909 sensor attaches interchangeably to either rail with its new ISO-CLAMP mounting which also effectively attenuates the most severe levels of rail shock and vibration as well as lightning-induced voltages; as a pioneer in the scanner business and therefore having the largest number of elderly units in the field, Servo is also busy providing kits for upgrading existing 7700-series units with new solid-state preamplifier, micropositioner, and pulse-processor vacuum tube and relay replacements for improved performance over an additional decade or so of service life.

—General Railway Signal's scanner was recently physically and electronically brought up to date; today's possibilities for enhancing data processing and interfacing capabilities with a microprocessor are such that GRS has several complete detector, processor and reporting systems in field test and is now pre-

Detectors: Installed or on the way

	Hotbox			Dragging equipment			Other**		
	In operation Dec. 1983	To be installed 1984	To be installed 1984-89	In operation Dec. 1983	To be installed 1984	To be installed 1984-89	In operation Dec. 1983	To be installed 1984	To be installed 1984-89
Alaska RR				3					
Algoma Central					2	4			
Amtrak	264* + 29	202*	174*	182			2		
Atchison, Topeka & Santa Fe	160	10		193	10		22		
Bangor & Aroostook		2							
Bessemer & Lake Erie	7			11			2		
Boston & Maine	7		9	3		9	3		3
British Columbia			5			5			5
Burlington Northern	248	28	90	120					
Canadian National	256	23	50	255	23	50	1	10	
Canadian Pacific	232	23		232	23		195	23	
Chessie System	116	72	117	84	79	117	1		
Chicago & North Western	55	23	41	2	23	41		22	35
Chicago, Milwaukee, St. Paul & Pacific	19	6	15	7			3		
Conrail	282	25	85	746	25	85	51	8	14
Delaware & Hudson	8		10	8		10	1		4
Denver & Rio Grande Western	33	5	10	381	24	35	15		
Duluth, Missabe & Iron Range	7			19	2		1		2
Elgin, Joliet & Eastern	1			2			1		
Florida East Coast	20			20			22		
Grand Trunk Western	24		2	24		2			
Illinois Central Gulf	93			84			91		
Kansas City Southern	75			82	8	8	37	5	19
Maine Central			7			7			3
Missouri-Kansas-Texas	30	1	5	30	1	5		1	6
Missouri Pacific	161	13	50	169	13	50	2		
Norfolk Southern (NW)	172	1		173	1		172	1	
Norfolk Southern (SOU)	187			256			37		
Quebec, North Shore & Labrador	11			7		17			
Richmond, Fredericksburg & Potomac	10		2	24			1		
Seaboard System	376	12	30	369	76	30	10	1	
Soo	21	2	10	18	2	10	22	2	10
Southern Pacific	287	2		697	2		71	4	
Union Pacific (incl. WP)	173	9	10	154	37	58	3		
Total	264* + 3,100	202* + 257	174* + 548	4,355	351	543	766	77	101

*On-board hotbox detectors in service on various Amfleet equipment
**Includes hot wheel, loose wheel, flat wheel, and outsized load detectors

Conrail hot box detector installation at Harmersville, Pa. with display board readouts. Following highly favorable train crew reactions to its first 11 "talker" installations in 1980-81, Conrail began large-scale applications and currently has more than 450 hot box, hot wheel and dragging equipment detectors with voice readouts, generally providing more complete information on multiple detectors than practical with the limited number of auxiliary indication lights used along with the axle-count display board. Photo: John S. Murray

pared to supply a complete multi-sensor wayside detection, analysis and reporting package.

• Another microprocessor revolution. If there was ever a ready-made application crying for the ministrations of a microprocessor, the hotbox scanner is it. At best, only subtle distinctions exist between the heat signature of a bearing that's good for another million miles and one that may be ready to heat up and burn off within the next few miles; analysis going far beyond simply comparing indicated journal temperatures at the ends of the same axle is necessary if the best possible "to alarm or not to alarm" decision, taking into account all available known effects of air temperature, solar heating, wind and so on, is to be made and acted upon in real time while the train is thundering by at speed.

If still not exactly duck soup for the microprocessor, such on-site analyses have rather suddenly become both conceivable and, in comparison to the cost of the scanner optics, quite affordable.

Some fairly high-powered thinking is going into the selection and implementation of alarm criteria, and trade-offs remain: How does discrimination capability which might be derived from a triple analysis of bearing data from the entire side of a 150-car train—which a micro can make in less than second—compare with the benefit of sending an alarm the instant a possible emergency-level signal is established on the basis of a sophisticated one-car/eight-bearing algorithm? At this point, there's room for argument—and the already-exploited capability of today's processors to generate and transmit more than a single level of alarm sometimes may make it possible to have things both ways.

A premise behind establishment of the FRA's Wayside Detection Research Facility at Pueblo Transportation Test Center in 1978 was that microprocessor integration of the analysis and reporting of multiple sensors could be a good thing if only it were demonstrated to the industry. Funding to complete the planned program ran out, and the WDRF is now inactive; the microprocessor revolution in this area, having generated its own steam, is in effect coming to pass anyway.

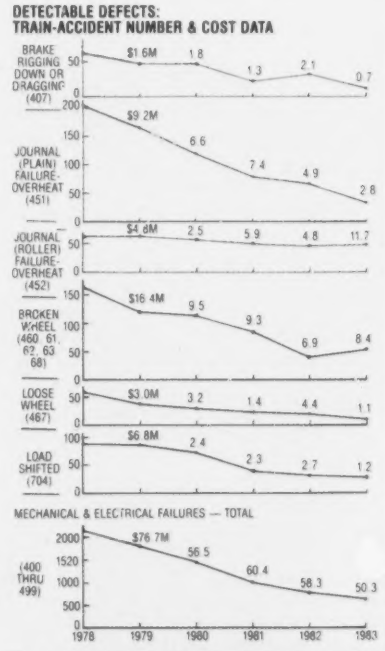
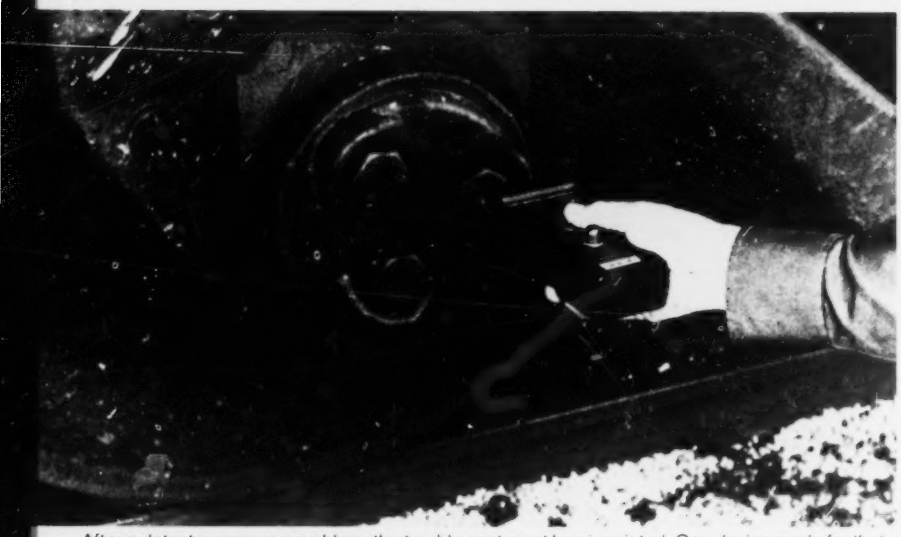


Fig. 1: Number (left axis) and total reportable cost ($ million) of selected categories of train accidents attributed to classes of defect susceptible to some degree of preventive monitoring or detection. Data from FRA annual Accident-Incident Bulletins, 1978 through 1983; accident-category line numbers in parenthesis.

• The instant buggywhip. When it comes to a sudden shift in technology and the resulting reduction of a substantial product line to buggywhip status, however, the effect of the caboose-off agreement and microprocessor adjuncts on the preferred detector readout really stands out.

As an alternative to the scoreboard display alerting the rear-end crew to the general nature of any defects picked up by the sensors and giving a single axle-count location of the first one detected, the "talker" with its music-box radio playback was first installed by Seaboard in the late 1970's. It not only eliminated a bulky wayside installation but presaged the ultimate cabooseless consist by allowing its message to be picked up by a crew member regardless of his location on the train.

At first based on the somewhat clumsy technology of picking out appropriate messages from a pre-recorded tape, the talker was considerably reduced in size, complexity and cost as soon as microprocessor voice units became available; now that the eventual concentration of crew members on the head end of the train has become a solid bet, choosing a detector read-out method has typically become a matter of deciding whether the radio message to the crew should come via a central analysis and recording office or be generated and transmitted automatically at the detector site; or perhaps—given the message generating, digitizing, classifying and routing capability inherent in the wayside micro-



After a detector senses a problem, the trouble spot must be pinpointed. One device made for that task is the Servoprobe, a hand-held train inspection verifier that counts axles and digitally displays wheel or journal temperatures.

processor—both ways. *Hot* bearing alarms, for example, may be transmitted directly and immediately to the crew; *warm* indications go to central for further analysis.

So, scoreboard-readout sales have dropped essentially to zero. The big end of the detector stick for many railroads for the next few years will be an orderly conversion program to achieve all-talker status, and talker suppliers are—at least proportionally to the number of units involved—as numerous as purveyors of IBM-compatible personal computers.

Typical is Southern Pacific's 1984 program: New installations include two hotbox, four hot wheel and two dragging equipment detectors (all with voice readouts); 140 of its 287 existing HBD's and 368 of 697 DED's are to be converted to talkers.

• **Finding the rascal.** Every railroad with a network of detectors in service has experienced the frustration of stopping a train on the detector's indication of a hotbox or dragger, finding nothing from on-the-ground inspection, and letting the train resume its journey only to have it demonstrate the power of modern technology and Murphy's law by piling up a few miles down the road from the effects of the very trouble that was sensed but not pinpointed. Estimates of what the effectiveness of the inspection process *should* be differ if made at a desk in the office rather than at trackside in the dark in rotten weather; in any case, developing changes in train crew consist and deployment are bound to affect the real-world answer.

Is some sophistication in order? Servo has ready its "Servoprobe" hand-held train inspection verifier which will count axles and read out wheel or journal temperatures on its digital displays. An item that would have to be spread around in quantity to be used effectively over a major railroad, and one that will remain fairly expensive unless commitments justifying large scale production are made, it has already found favor on some overseas heavy-haul railroads where one unit per trainset can really speed up the process of run-by inspection of a cabooseless unit train halted by a detect indication.

• **On-board detection.** With the best of wayside detectors, some hotbox accidents will still occur when bearing heating starts soon after passing the scanner and progresses to burn-off before the next check point; the remedy is a full-time, on-board detector. While FRA-supported projects to develop and prove such systems for freight service have petered out for lack of funding, routine continuous monitoring of a significant number of passenger train bearings has now become an accomplished fact.

Amtrak's 640 Amfleet I and II cars, many now in service at 120 mph on the Northeast Corridor, have Pioneer III trucks whose inside, rubber-doughnut-enclosed bearings cannot be surveyed by wayside scanners. Following up on a program (*RA*, Nov. 10, 1980, p. 31) to develop a nonproprietary monitoring system, Amtrak has already equipped 264 cars and its AEM-7 electric and F-40PH diesel locomotives hauling them with Safetran-supplied monitoring hardware and has the remaining 376 inside-bearing cars programmed for retrofit.

A green light in the locomotive cab, in communication via a wire in the trainline jumpers with any equipped cars in the consist, verifies sensor circuit integrity and safe bearing temperatures. Any trouble indication extinguishes the green light, activates a beeper in the affected car, and indicates on a local panel the truck in question for temperature-stick (200 deg. F) investigation after the train has been stopped.

• **Beyond the hotbox.** As if to re-emphasize the fact that *any* burned-off-journal accident *can* turn out to be *very* expensive, the reportable damage total for 1983's record low number of such happenings was $14.5 million dollars—higher than for the considerably larger number of them occuring during any one of the five previous years, as shown in Fig. 1, and close to the $15.1 million reportable cost for the 409 such accidents racked up a decade earlier in 1970. Overcoming a 292% price index increase over the 13 years to stay below that dollar-damage total in a bad year remains a feat which any detector salesman or railroad C&S officer might like to mention.

Also included in Fig. 1 are numbers and reportable-damage totals for those other major accident causes for which at least the possibility of cost-effective defect detection exists.

As it happens, detectors for at least some aspects of all these causes are in service; dragging equipment detectors (which of course catch other misplaced items besides those brake rigging components that are their main fodder) will continue to lead the field, in numbers if not in cost or sophistication, with over 300 to be installed or upgraded in 1984. An attractive upgrade in this microprocessor era is tying the DED into the hotbox talker's processor so that the crew also gets the axle count of any dragging equipment indication and can check out the situation with less walking and delay.

Receiving spottier acceptance so far are hot-wheel detectors. Some roads such as Canadian Pacific are attacking the problem of thermal wheel abuse and its possibilities for later catastrophic failure by routinely locating one at every HBD DED site. Partisans of the separately-aimed hot-wheel scanner can cite extensive experience indicating that it typically catches (particularly if located near a yard exit) at least twice as many problems as the HBD—struck brakes, mis-set retainers, unreleased hand brakes and the like—at an add-on cost of less than 20% that of a modern HBD.

Others remain less convinced, suggesting that the augmentation of a hub-scanning hotbox sensor with sophisticated processing which can properly interpret slightly warm readings on four or eight wheels of a car as a brake problem may accomplish much the same purpose less expensively.

Also fairly widespread, with over 200 installations reported in service now and a few more expected each year, are outsize-load ("high-wide") detectors. Intercepting both misrouted—statistically a very minor problem—and shifted loads before they impact overhead or wayside obstructions with at least embarrassing and assuredly expensive consequences, detector configurations tend to be specific to the particular site. As a result, the total number of installations has sometimes seemed to be little larger than the number of suppliers (a majority of them railroad signal departments rolling their own), and some

"commercial" systems have gone off the market for lack of volume.

Simple in principle and operation, loose-wheel detectors in which electrical contact between a wheel which has slipped into narrow gauge completes an electrical circuit with a spring-loaded sensor bar (Safetran continues to supply the veteran "Rails" device) are primarily effective at yard speeds or slightly above. Some 300 installations are in service, but on only 9 railroads—notably, FEC, ICG and NW. With the practicability of combining their output with other sensors at a site, however, several additional roads expect to install some within the next few years.

• **Train-dynamics monitoring.** In the face of diminished R&D funding, FRA has continued limited support for a task exploring the use of track/wheel force measurements to detect such potentially critical items as unreleased handbrakes and L/V force ratios approaching derailment levels. Several possibilities are at least theoretically promising, although reliably measuring and analyzing these second-order forces day in and day out, outdoors, in the face of the railroad mechanical and electrical environment remains technically challenging with or without a microprocessor.

Meanwhile, a significant milestone in putting such instrumentation-type technology to work has been passed with the installation of Amtrak's "Kips Machine" at Edgewood, Md. Officially labeled a wheel impact load detector, the installation has four strain gauges on the rail web measuring forces generated by 10-inch segments of the circumference of passing wheels. Microprocessors digitize the resulting signals and transmit calculated wheel input forces exceeding a threshold (currently 60,000 pounds—60 kip's) by phone circuits to printers in Washington and Philadelphia. Indentifiable to the specific axle responsible, excessive loads are cause for shopping of an offending car.

Specific cause for the investigation (with Battelle Columbus Labs, which also developed the detector system) leading to this installation was extensive rail-seat cracking—troublesome though not life-threatening—occurring in concrete ties under the Corridor's mixed heavy freight and high speed passenger traffic. Primary culprit? The combination of high speed and a peculiar type of out-of-round wheel developing on some Amfleet I and Heritage Fleet (rebuilt pre-Amtrak) cars. Not "flats" in the usual sense, these wheel defects are not readily visible to a car inspector but can generate rail-seat forces greater than more heavily loaded flat wheels on freights at their speeds. With the KIPS machine and its successors in service, such dogs will get no more than one bite at the right-of-way.

• **Identifying broken wheels.** Broken wheels—failures in flange, rim, plate or hub or thermal cracking—remain a costly problem, in some years exceeding heat-broken journals in aggregate reportable damage, as a look at Fig. 1 will show. A cooperative FRA-AAR program, its $3.2 million of Federal funding this year representing the agency's principal R&D commitment, continues to seek better ways for identifying the wounded wheels before it's too late.

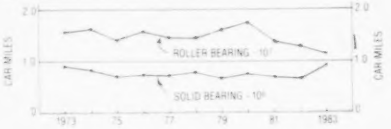
One facet of the program monitors progress of the numerous parties searching worldwide for that particular Holy Grail that has been attracting metallurgists, physicists and mechanical engineers for many, many decades: a nondestructive procedure capable of determining the state of residual stress.

The other major prong of the offensive is a brute-force approach toward identifying those particular forms and degrees of thermal abuse which do and do not result in hazardously weakened wheels. A monster dynamometer formerly located in U.S. Steel's laboratories has been acquired and moved to the AAR Technical Center in Chicago. Now situated so that wheel-abuse tests can be routinely carried to destruction, it is hoped that this machine may represent the key but previously-unexploited weapon permitting a more realistic, extensive and ultimately fruitful assault on the problem. ■

The hotbox story: 1973-1983

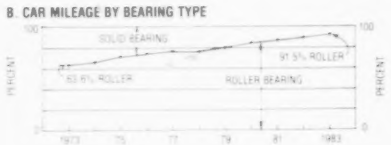
As a continuing major source of damage, delays and expense despite the phasing in of roller bearings and the ten-fold improvement in solid-bearing performance achieved by the elimination of loose waste packing in favor of journal pad lubricators in the late 1950's, overheated journals are tracked by special report to the AAR's Operations and Maintenance Department. Results go quarterly to chief mechanical officers of the member U.S. and Canadian roads; historical summaries for all years from 1973 on are comparable with data currently being collected.

A. CAR MILES PER OVERHEATED BEARING



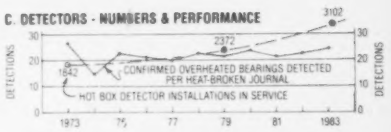
Fleetwide performance levels for both roller and solid bearings have remained generally static during the period. Mileage per hotbox for roller bearings has fluctuated between 12 and 24 times that for solid bearings; for 1983, it was near the bottom end of that range as performance of the remaining solid-bearing cars improved considerably.

B. CAR MILEAGE BY BEARING TYPE



The percentage of total miles run by roller-bearing cars has increased steadily, introduction of roller bearings via new-car installations in heavier-traffic periods being matched to some degree by increased rates of retirement or storage of older solid-bearing cars when traffic is lower.

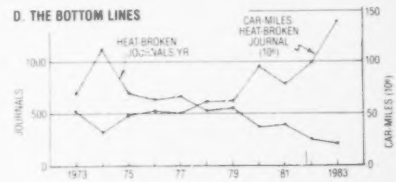
C. DETECTORS - NUMBERS & PERFORMANCE



Since the introduction of infra-red journal bearing scanning in 1956 there has been an accelerating rate of detector development and installation which, with the concentration of traffic on fewer miles of main track, has resulted in better scanning of train bearings at increasingly frequent intervals. However, probably primarily because a roller bearing that does run hot tends to progress to axle failure more rapidly, the *overall* ratio of detected hotboxes to heat-broken journals has improved only marginally as the percentage of solid bearings has decreased in recent years. Twenty-four hot bearings were detected in 1983 for every heat-broken (undetected) journal.

Detectors-in-service data for 1972 and 1980 are from surveys by Committee F of the AAR Communication & Signal Division; 1983 data were collected by *Railway Age*.

D. THE BOTTOM LINES



Net result has been a fairly steady decrease in the number of failures in service as solid-bearing car-miles have decreased by 75%; overall, car-miles per heat-broken journal reached a new high of 140 million in 1983, more than double that of the early 1970's.

AAR journal bearing performance statistics are not directly comparable with U.S. FRA figures for corresponding failures because they represent a somewhat different car fleet (including Canadian roads) and failures reported are not subject to the reportable-damage threshold applicable to accident data.

A RAILWAY AGE SERVICE PAGE

REVENUES AND EXPENSES OF RAILWAYS

First quarter figures of calendar year 1984

(Dollar figures are stated in thousands, i.e., with last three digits omitted)

		Operating revenues				Operating expenses								Operating Ratio		Income after fixed charges		1984 Net Ry. operating income	Net income	
						Ways & structures			Equipment											
		Freight	Other	Total 1984	Total 1983	Total 1984	Total 1983	1984 Deprec.	Total 1984	Total 1983	1984 Deprec.	Total 1984	Total 1983	1984	1983	1984	1983		1984	1983
Amtrak	3 mos.	—	159,405	159,405	146,953	66,820	38,687	29,252	90,446	90,204	19,926	386,200	341,383	242.27	232.30	(220,138)	(212,043)	(226,795)	(220,138)	(212,043)
Atchison, Topeka & Santa Fe	3 mos.	572,697	9,002	581,699	485,920	85,203	77,281	14,680	141,785	123,710	23,677	533,077	483,817	91.64	99.56	47,005	(3,493)	33,517	31,651	(3,227)
Baltimore & Ohio	3 mos.	254,990	10,368	265,358	196,069	44,992	33,240	9,849	58,496	54,375	7,230	251,567	201,812	94.80	102.92	11,682	(10,024)	16,548	8,427	(8,314)
Bessemer & Lake Erie	3 mos.	11,363	1,698	13,061	10,302	3,643	2,804	1,288	1,763	1,976	1,074	15,610	15,679	119.51	152.19	(2,203)	(5,156)	(1,580)	(1,233)	(2,497)
Boston & Maine	3 mos.	29,781	1,400	31,181	27,495	4,083	5,210	181	9,492	8,438	321	29,802	29,882	95.57	108.68	1,998	(1,815)	1,454	1,998	(2,003)
Burlington Northern	3 mos.	1,100,989	23,029	1,124,018	993,316	151,258	154,031	37,061	197,945	178,985	16,231	902,257	842,840	80.27	84.85	241,472	133,324	120,104	139,805	77,459
Chesapeake & Ohio	3 mos.	241,814	6,113	247,927	210,935	37,465	28,425	8,034	58,255	50,363	3,257	230,233	195,386	92.86	92.62	29,283	9,372	9,078	20,703	5,134
Chicago & North Western	3 mos.	206,796	25,808	232,604	196,931	37,261	32,563	5,957	56,930	49,126	4,482	222,974	192,757	95.85	97.88	1,600	(55)	9,405	1,375	(55)
Chicago, Milwaukee, St. Paul & Pac.	3 mos.	100,993	3,659	104,652	86,977	19,665	13,304	5,908	30,960	23,988	2,882	104,172	83,420	99.54	95.91	976	1,416	476	571	3,225
Conrail	3 mos.	811,043	29,661	840,704	718,014	131,979	120,059	22,430	198,468	189,546	35,972	755,881	701,296	89.91	97.67	90,860	10,252	79,984	90,860	18,568
Delaware & Hudson	3 mos.	27,741	2,850	30,591	23,983	4,943	4,502	35	9,420	7,813	434	31,829	27,421	104.04	114.33	(1,694)	(6,034)	(1,209)	(1,694)	(6,034)
Denver & Rio Grande Western	3 mos.	86,623	1,592	88,215	69,684	13,943	9,319	2,756	16,994	14,181	3,106	80,778	63,670	91.56	91.36	4,614	6,056	6,024	3,071	4,813
Duluth, Missabe & Iron Range	3 mos.	14,321	316	14,637	9,410	6,582	4,780	1,492	2,764	2,241	794	18,705	14,102	127.79	149.86	(3,616)	(4,488)	(3,064)	(2,032)	(2,214)
Elgin, Joliet & Eastern	3 mos.	18,345	9,212	27,557	21,769	3,110	2,468	684	3,201	2,734	1,879	22,866	19,289	82.97	88.60	5,652	3,322	2,324	3,285	1,788
Florida East Coast	3 mos.	30,779	395	31,174	25,619	4,364	5,006	1,132	5,372	3,872	1,122	22,485	19,691	72.12	76.86	11,885	7,650	3,759	6,946	4,456
Grand Trunk Western	3 mos.	80,316	4,237	84,553	52,102	10,142	6,422	1,747	19,481	12,216	1,598	83,512	56,891	98.76	109.19	(443)	(5,604)	2,553	(1,067)	(4,276)
Illinois Central Gulf	3 mos.	233,499	20,923	254,422	223,703	29,982	23,701	11,513	72,480	70,949	5,042	236,890	216,773	93.10	96.90	15,340	223	15,852	13,180	(107)
Kansas City Southern	3 mos.	78,665	3,668	82,333	74,933	12,067	13,209	3,676	20,506	18,306	5,043	71,194	67,899	86.47	90.61	8,946	5,945	7,656	5,438	4,467
Missouri-Kansas-Texas	3 mos.	DATA NOT AVAILABLE AT PRESS TIME																		
Missouri Pacific	3 mos.	431,745	11,368	443,113	414,005	60,462	61,320	11,934	96,583	100,992	18,215	391,869	373,972	88.43	90.33	42,544	27,277	40,060	29,000	16,812
Norfolk & Western	3 mos.	422,014	15,870	437,884	347,418	80,057	74,492	10,512	82,723	71,469	13,271	361,126	330,868	82.47	95.23	100,156	35,696	35,325	57,454	22,663
Pittsburgh & Lake Erie	3 mos.	11,348	429	11,777	9,482	1,693	1,861	245	4,173	5,027	360	13,960	15,543	118.53	163.92	(4,384)	(8,402)	(2,180)	(4,384)	(8,402)
St. Louis Southwestern	3 mos.	109,778	1,426	111,204	84,112	14,388	10,816	4,199	28,303	20,602	5,575	97,983	77,937	88.11	92.65	15,048	5,409	8,162	9,989	3,735
Seaboard System	3 mos.	692,909	14,720	707,629	606,574	82,340	86,836	15,517	166,126	154,322	15,432	590,304	557,013	83.40	91.80	116,345	39,750	79,210	75,558	35,590
Soo Line	3 mos.	81,668	1,867	83,535	66,685	13,648	11,045	2,826	19,384	15,934	2,034	76,076	62,938	91.07	94.38	8,069	3,793	4,483	4,900	2,340
Southern	3 mos.	432,559	10,176	442,735	383,205	61,768	49,035	16,952	90,300	79,403	18,568	360,231	323,343	81.36	84.37	80,931	52,843	50,005	46,552	30,115
Southern Pacific	3 mos.	529,977	17,452	547,429	462,498	62,044	84,061	20,788	163,076	130,003	21,051	549,705	500,181	100.41	108.14	15,748	(38,063)	10,890	28,914	(34,339)
Union Pacific	3 mos.	496,455	5,978	502,433	445,090	75,162	59,551	16,833	112,315	93,860	23,616	456,380	399,223	90.83	89.69	41,980	38,284	30,856	26,735	23,592
Western Pacific	3 mos.	38,527	677	39,204	40,811	7,454	6,664	729	8,541	10,768	1,828	43,643	46,913	111.32	114.95	(7,109)	(3,749)	(819)	(3,509)	(2,042)

Source: Interstate Commerce Commission

NOTE

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